ANNOUNCEMENT

Program Announcement LAB NE-2001-2
Nuclear Energy Plant Optimization (NEPO) Program
U.S. Department of Energy (DOE)
Office of Nuclear Energy, Science, and Technology (NE)
Office of Technology and International Cooperation (NE-20)

ACTION: The DOE national laboratories are invited to submit field work proposals (FWP) for possible funding under the NEPO Program.

SUMMARY: DOE is interested in receiving field work proposals (FWP) for the specific research and development (R&D) activities described in this announcement.

The NEPO Program is based on the *Joint DOE-EPRI Strategic Research and Development Plan to Optimize U.S. Nuclear Power Plant*s. The NEPO Program R&D activities are cost shared with industry and jointly managed with the Electric Power Research Institute (EPRI). DOE has established a cooperative agreement with EPRI to conduct and jointly manage R&D activities funded under the NEPO Program. This program announcement solicits FWP from DOE national laboratories that are the sole or lead organization for the proposed R&D activities. Preference will be given to those FWP which propose participation of a minority owned business(es) or minority educational institution(s). Accredited Postsecondary Minority Institutions are listed on the web site: http://www.ed.gov/ocr/minorityinst.html.

DATES: The deadline for receipt of formal FWP is March 30, 2001.

ADDRESS: All FWP responding to Program Announcement LAB NE-2001-2 should be sent to Joseph A. Bartell, Nuclear Energy Plant Optimization Program, Office of Technology and International Cooperation (NE-20), 19901 Germantown Road, Germantown, Maryland 20874.

An original and five copies of the FWP shall be submitted by U.S. Postal Service, commercial mail delivery service, or hand-carried by the proposer to the address stated above. In addition to an original and five hard copies, an electronic copy of the entire proposal prepared in Word Perfect or Microsoft Word on an IBM compatible write protected 3.5-inch disk shall be included in the submittal. FWP will not be accepted by fax or electronic mail. The label on the diskette must clearly identify the institution, project manager, task ID, title from the scope of work, and the computer program (s) used to prepare the document. Unsuccessful proposals will not be returned.

ELIGIBILITY: This program announcement invites FWP from DOE national laboratories acting as the sole or lead organization conducting the R&D activities.

AWARDS: It is anticipated that the awards will be made in FY 2001. FWP will be funded for the performance period specified for each task in the scope of work, contingent upon the availability of funds. Up to a total of $375,000 of FY 2001 funds are available for awards under this program announcement. Estimated available funds for each of the R&D activities described in this announcement are specified in the scope of work. DOE reserves the right to fund, in whole or in part, any, all, or none of the FWP submitted in response to this program announcement.

BACKGROUND: For background on the NEPO program including program goals and research areas, please visit the web site: http://nepo.ne.doe.gov

SCOPE OF WORK: This program announcement includes the following three R&D tasks for FY 2001. A laboratory may respond to one or more of the tasks described here. A separate FWP is required for each task. Details of work scope are identified in attachments noted at the end of the task title.

Task 5-110.2: Human Factors Guidance for Digital Instrumentation & Control (I&C) Systems and Hybrid Control Rooms (See Attachment A)

Task 5-113.1: On-line Monitoring of Non-redundant Sensors for Signal Validation and Calibration Reduction (See Attachment B)

Task 5-117.3: R&D Needs to Address Potential Nuclear Plant Vulnerabilities Arising from Transmission Grid Voltage Inadequacies (See Attachment C)

FORMAT AND INFORMATION TO BE INCLUDED IN THE FIELD WORK PROPOSAL

(Reference DOE Order 5700.7C,
"http://www.explorer.doe.gov:1776/pdfs/doe/doetext/oldord/5700/o57007c.pdf")

A separate FWP is required for each task described in the scope of work of this program announcement for which the laboratory is proposing to perform the work. The FWP is to be prepared and submitted consistent with policies of the laboratory submitting the proposal and the local DOE operations office. All budgets should be expressed in U.S. dollars, specified for each year of the project on an elapsed time basis, and not a fiscal year basis. Where collaborative efforts are proposed, the individual responsibilities of participating organizations should be identified. As a minimum, the following information should be included in the FWP:

- Standard face page (Attachment 3 of DOE Order 5700.7C)
- Table of Contents
- Task ID, Title and Abstract
- Description of proposed work. This may include proposed enhancements to the approach outlined in the scope of work included in this program announcement. This should include, if applicable, a description of the scope of work beyond the period funded in this program announcement to achieve the overall objective of the project.
- Schedule, milestones, and estimated funding requirements - including those, if applicable, proposed for meeting the overall objective of the project beyond the work scope identified in the program announcement for FY 2001 funding.
- Collaborative R&D (if applicable) - description of the collaborative arrangements defining responsibilities and tasks assigned to each participating organizations (up to two pages)
- Organization and Qualifications - identification of the project organization and qualifications and responsibilities of participating organizations and key project personnel (no more than two pages each)
- Facilities and Resources - information on the experience of the applicant organization and the adequacy of required facilities and resources (no more than three pages)
- Budget for each participating organization for each year and for the total project period (using DOE F.4620.1); all budgets should be based on 12-months elapsed time and not on a fiscal year basis.
- Additional information the applicant deems relevant may be included.

An original and five copies of the FWP shall be submitted by U.S. Postal Service, commercial mail delivery service, or hand-carried by the proposer to the address stated above. In addition to an original and five hard copies, an electronic copy of the entire proposal prepared in Word Perfect or Microsoft Word on an IBM compatible write protected 3.5-inch disk shall be included in the submittal. FWP will not be accepted by fax or electronic mail. The label on the diskette must clearly identify the institution, project manager, task ID, title from the scope of work, and the computer program (s) used to prepare the document. Unsuccessful proposals will not be returned.

FIELD WORK PROPOSAL EVALUATION:

All valid FWP will be evaluated as follows:

- DOE will perform an initial review for conformance with the technical and administrative requirements stated in this program announcement and for funding availability.
- For those FWP that successfully complete the initial review, an evaluation will be performed by a technically and professionally qualified evaluation team consisting of one member each from DOE and EPRI staff and two members from electric utilities. Preference will be given to those FWP which propose participation of a minority owned business(es) or minority educational institution(s). For a list of Accredited Postsecondary Minority Institutions, visit the web site: http://www.ed.gov/ocr/minorityinst.html. This evaluation team will rank the FWP using the following criteria:

  1. Technical quality of the FWP to include: a) completeness and clarity of the technical proposal and b) appropriateness and adequacy of the proposed methodology or approach

  2. Capabilities and qualifications of the project manager and key personnel and adequacy of resources and facilities applied by participating organizations

  3. Reasonableness of project cost and schedule, including allocations among multiple participating organizations, where applicable.

  4. Participation of minority owned businesses or minority educational institutions.

INTELLECTUAL PROPERTY RIGHTS

With respect to intellectual property, the patent and data provisions set forth in the national laboratory's management and operating contract shall be used.

STATUTORY AND REGULATORY AUTHORITY

The NEPO Program is being conducted under the authority of the FY 2001 Energy and Water Appropriations Bill, PL 106-377.

PROGRAM ANNOUNCEMENT QUESTIONS & ANSWERS

DOE does not intend to hold a preproposal conference. You may submit your written questions via e-mail to joseph.bartell@hq.doe.gov by March 9, 2001. Responses to these questions will be placed on the DOE NEPO web site at http://nepo.ne.doe.gov, in the Notices section.

FOR FURTHER INFORMATION CONTACT:

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Nuclear Energy Plant Optimization Program
U.S. Department of Energy
19901 Germantown Road, Germantown, Maryland 20874-1290

Task 5-110.2 Human Factors Guidance for Digital Instrumentation and Control (I&C) Systems and Hybrid Control Rooms

Estimated Available Funds for FY2001
The estimated FY 2001 available funds for this task in FY 2001 are $200,000.

Period of Performance for FY2001 Funding
The FY2001 award is for a 12-month performance period.

Project Period of Performance
The expected duration of the entire project is 24 months

Objective:

The major objective of this project is to develop, test and evaluate, and publish a technically valid, practical, and user friendly human factors guidance document(s) for digital I&C systems and hybrid control rooms, including the supporting material (training materials, guidance for preparing new and/or modified procedures, and plan for maintaining and updating the guidance document) for use by designers/suppliers and utility engineers who are not human factors experts. The document(s) will provide guidance for specifying, designing, implementing, operating, and maintaining digital I&C systems and interfaces.

Background:

Nuclear power plants rely on instrumentation & control (I&C) systems for control, monitoring, and protection. The majority of nuclear plant I&C systems are of analog design, and contain components that are or soon will become obsolete. In many instances, analog replacements are not available. To respond to equipment obsolescence or to obtain desired performance improvement, nuclear power plants are procuring digital-based systems. I&C equipment and control room modernization is expected to accelerate as plants age, as more plants receive license renewals, and as the benefits of digital technology become necessary to increase the cost-effectiveness of electricity production. In many cases, the implementation of digital systems in the control room will result in a combination of analog and digital equipment and human-system interfaces (HSI) resulting in a hybrid control room.

Concern is arising that if new digital systems and hybrid control rooms are not designed, implemented, operated, and maintained correctly from a human factors point-of-view, the potential for human errors will increase and the benefits of the new technology will not be achieved. Consideration of current human factors (HF) knowledge and guidance in the specification, design, implementation, use, and maintenance of digital I&C systems is critical. Careful design of human-system interfaces utilizing digital technology, and integration of these interfaces into control rooms, can provide I&C capabilities permitting personnel to accomplish their roles effectively in such tasks as process and equipment monitoring, fault detection and diagnosis, situation assessment, response planning, and response execution. The results can be

reduced human errors and inefficiencies, and thus enhanced plant safety, availability, reliability, and efficiency.

Although numerous human factors guidelines have been published, the specific guidance needed both to satisfy safety requirements and to achieve high levels of availability, reliability, and efficiency in nuclear power plants is not readily available. The U.S. Nuclear Regulatory Commission (NRC) has published the best-known human factors guidance documents in the nuclear power generation industry, many of them being very recent. These documents are intended for use by NRC regulators in reviewing proposed HSIs and control room upgrades regarding safety issues. These documents do not provide the additional guidance needed to specify, design, implement, operate, maintain, and provide cost-effective, integrated HSIs to achieve high levels of availability, reliability, and efficiency. Issues such as role of the operator, increased use of automation and computer-based procedures, and use of data processing to create HSIs that provide information in a form not previously possible, are not handled well by the existing NRC guidance documents. Information is available from other sources and from experience and this information can be used in conjunction with these NRC documents to prepare the applicable human factors guidance.

The guidance developed in this project should be value-based to allow the guidelines to be realistic and enable them to be implemented cost-effectively. Risk-informed considerations should be part of the technical basis for the guidance. The guidance should be able to be implemented using currently available technology and equipment, but be applicable to new technology, to the extent possible. The guidance should be user friendly for designers and utility engineers who may not be human factors experts. As much as possible, checklists should be included in the guidelines. The guidance should be easy to use by utilities to identify specifications for suppliers.

Task Scope of Work:

The document(s) developed under this project will provide a checklist of key attributes that must be addressed to comply with regulations including basic guidance and suggested references in different aspects of control room modernization (e.g., alarm system, alarm procedures, CRT-based displays, soft controls, automation, etc.). The objective is to provide, in a simplified manner, minimum aspects that should be considered when dealing with control room modernization and the implementation of digital I&C systems.

Developing the human factors guidance for digital I&C systems and hybrid control rooms project will require a team of industry experts and national laboratory experts. The purpose of this program announcement is to select national laboratory experts. The industry experts will be selected separately. The selected national laboratory and industry participants will be teamed for the overall project. The estimated funding of $200,000 is for the scope of work to be performed by the selected national laboratory.

The guidance development is expected to involve at least the five major tasks described below. Other tasks may be proposed. For each task, the anticipated national laboratory involvement is

described. For this program announcement, the responding national laboratories should describe how they will perform Tasks 2 and 3, and how they will provide input for Tasks 1, 4, and 5. Cost estimates should be based on this split of the effort in this program. Field work proposals should describe the approach proposed for both FY2001 funds and for the entire duration of the proposed project.

Task 1: Define Contents of the Guidance Document and Supporting Materials Based on Designers' and Utilities' Needs

The industry experts will perform this task with input from the national laboratory experts.

The selected contractor(s) will interface with utilities, designers/suppliers, and the NRC, review existing documentation, and apply their own expertise to define the contents of the guidance document and supporting materials based on utilities' and designer's needs and concerns. Nuclear regulatory guidance documents and requirements, and guidelines from other industries should also be considered.

Task 2: Develop Technical Basis for the Human Factors Guidance

The national laboratory experts will perform this task with input from the industry experts.

This task is to develop a valid and defensible technical basis for the human factors guidance for digital I&C systems and hybrid control rooms. This technical basis is to be developed based on standards, regulations, guidelines, current practices, research results, and other appropriate resources both domestic and international. Nuclear industry resources need to be evaluated along with resources from areas such as aerospace, military, universities, and the process industry. Current and modern state-of-the-art practices are to be included. Advanced plants and advanced plant designs should be considered both for an identification of the areas to be addressed as well as for guidance. The NRC has issued several NUREGs addressing human factors issues for digital systems. These NUREGs, although designed for regulatory review, include technical bases which must be understood and factored into the technical bases developed, as well as in the human factors guidance itself. The NRC's regulatory positions must be well understood and factored into the development of the technical bases. This technical basis should be retained in a living document and/or database to allow revisions as more information and experience become available.

Task 3: Develop Human Factors Guidance

The industry experts and the national laboratory experts will perform this task jointly.

Based on the results of Tasks 1 and 2, human factors guidance will be developed that is usable and useful for designers and utility engineers who are not human factors engineers. This guidance will be value-based to make sure that it can be applied cost-effectively. Risk-informed considerations will be taken into account as appropriate. The guidance will be valid and technically defensible and will be practical to use. The guidance should be able to be implemented using currently available technology and equipment, but be applicable to new technology, to the extent possible. The guidance should include checklists as much as possible to facilitate the use of the guidance by designers and utility engineers. Consideration should be given to identifying the range of applicability of the guidance to help the user easily identify what parts are relevant for a specific application. The guidance should be easy to use by utilities to identify specifications for suppliers. The guidance will address all of the issues identified in Task 1 and any others that are identified during this project.

Task 4: Test and Evaluate Human Factors Guidance

The industry experts will perform this task with input from the national laboratory experts.

The test and evaluation efforts will be concerned with the usability, acceptability, and completeness of the guidance as determined by representative users. Utility and designer personnel will be needed to support this test and evaluation task. Such topics as document content and format, will be considered in the testing and evaluation. In addition, the test and evaluation efforts will consider the quality of the digital systems and their HSIs produced and the integration of these interfaces into control rooms based on application of the draft guidance document(s). The test and evaluation should answer the question: do digital systems and the HSIs based on the guidance document(s) facilitate performance by operations, maintenance, and engineering personnel and reduce the potential for human error? The test and evaluation should also answer if the guidance is practical, can be achieved with currently available equipment, but be applicable to new technology, to the extent possible, and is user friendly even for non human factors experts. A test and evaluation plan will be submitted for approval prior to implementation.

Task 5: Develop Supporting Materials

The industry experts will perform this task with input from the national laboratory experts.

Supporting material will be developed to facilitate guidance document use and to upgrade and maintain the document(s) as required. Specifically:

- A training program will be created and tested for users of the human factors guidance document(s). Although the document must be designed to be usable without special training, it is expected that effective application of some of the methods could benefit from a training program.
- Guidance regarding procedure upgrades will be prepared.

- A plan for periodic updates of guidance and technical basis documents will be prepared. The guidance document(s) must provide the current guidance needed to support human factors submittals to the NRC as desired.
- Test and evaluation efforts will be required for the guidance provided in preparing new and/or modified procedures and training materials.

Deliverable Items:

For each of the listed tasks, a report documenting the results of the task will be submitted. For each task, a draft will be submitted to the EPRI and DOE program managers for review and approval before the final version is completed and submitted in EPRI report format. Intermediate guidelines that can be used by utilities and designers before the end of this project are expected.

Task 5.113.1: On-Line Monitoring of Non-Redundant Sensors for Signal Validation and Instrument Calibration Reduction

Estimated Available Funds for FY2001
The estimated FY 2001 available funds for this task are $100,000.

Period of Performance for FY2001 Funding
The FY 2001 award is for a 12-month performance period.

Project Period of Performance
The expected duration of the entire project is 36 months.

Objective: The overall objective of Project 5-113 is to provide assistance to operating nuclear power plants in assessing, implementing, and providing on-going support of signal validation technologies and quantification of benefits of on-line monitoring. The scope of work for this task relates to the application of on-line monitoring technology to nuclear power plants with the following objectives:

- Demonstrate on-line monitoring technology in an operating nuclear plant
- Identify the uncertainties with on-line monitoring in a manner consistent with how operating nuclear plants calculate setpoints for process parameters
- Understand the limitations of on-line monitoring when applied to process parameters that can be subject to significant variability

Background: EPRI has formed the Instrument Monitoring and Calibration (IMC) Users Group to provide instrumentation and control (I&C) services to EPRI members in technology transfer, training, and implementation of key IMC products. This EPRI Users Group provides a much-needed means for providing utilities with application support of these key products for improved reliability, lower operations and maintenance (O&M) costs, and ensuring safe operation of nuclear plants.

During 2000, the IMC Users Group started the transition from product demonstration to product implementation. In July 2000, the NRC issued a safety evaluation (SE) approving the use of on-line monitoring as a means of extending the calibration intervals of safety-related instrumentation. Topical Report TR-104965-R1, *On-Line Monitoring of Instrument Channel Performance*, was revised in September 2000 to reflect the NRC SE. In 2001, the IMC Users Group will coordinate the implementation of on-line monitoring at selected nuclear plants as part of a Tailored Collaboration (TC) program. The planned implementation of on-line monitoring for this project is with the Multivariate State Estimation Technique (MSET) Surveillance System. MSET was selected by the EPRI IMC Users Group for the following reasons:

- Topical Report TR-104965-R1, *On-Line Monitoring of Instrument Channel Performance*, is based on MSET as the preferred implementation for non-redundant parameters. The NRC has approved this topical report as a basis for on-line monitoring.

- The B&W Owner's Group, whose members are represented in the IMC Users Group, has selected MSET as the preferred method of on-line monitoring.

- An MSET uncertainty analysis can be prepared in a manner consistent with how commercial nuclear plants establish setpoints. For a given set of inputs, MSET will provide a consistent output. Neural network configurations were not considered because of the increased complexity of determining the algorithm uncertainty in a manner usable by nuclear plant setpoint programs.

- The EPRI-sponsored demonstration project required software that is readily available. The participating nuclear plants specified an early 2001 project start date.

Because MSET has been identified as the software selected by the EPRI IMC User's Group, the following paragraphs provide additional information regarding MSET.

MSET is a software-based, highly sensitive, and accurate tool for on-line monitoring of the health of any process that has at least one sensor. MSET can detect and identify malfunctions that might occur in process sensors, components, and control systems, as well as changes in process operational conditions. MSET uses statistically-based pattern recognition modules that interact and operate to provide the user with information needed for the safe, reliable, and economical operation of a process by detecting, locating, and identifying subtle changes well in advance of significant degradation that could be precursors to future problems.

The basic concept that is used by the MSET pattern recognition system is an integration of a system model that provides analytically derived values of all monitored sensor signals and a statistically-based hypothesis test that compares the analytically estimated signal values with the measured values to detect the development of incipient faults. MSET consists of three essential modules and a number of supporting modules. The essential modules are a training algorithm for collection of representative data from sensors during normal operation of the system, an empirically-based model for system state estimation, and a statistically-based fault detection algorithm. The training module is used to produce a training set whose data ideally encompass all expected normal operating states of the system. The system modeling module is used to estimate the values of all signals that are present in the process that is being monitored. The fault detection module is used to detect disturbances through an examination of the difference between the estimated and measured signal values.

To utilize the MSET Surveillance System, all that is necessary for the user to do is collect from the process under consideration sensor-generated data that bounds all normally expected operational states. These data are used by the MSET system to establish the domain of normal process operation (referred to as *training* MSET to recognize normal behavior) and will be used in the monitoring phase to identify abnormal behavior. During monitoring, sensor data are read by MSET, an estimate of the current state of the process is determined by comparing the measured sensor data with that obtained during training, and the difference between this state estimate and the measurement is calculated. This difference or estimation error is then analyzed by a statistically-based hypothesis test (the Sequential Probability Ratio Test or SPRT) that determines if the process is operating normally or abnormally. If an abnormal

condition is detected, the initial diagnostic step identifies the cause as either a sensor degradation or an operational change in the process.

This project is a demonstration of on-line monitoring for a variety of applications at multiple nuclear plants. Proposals can be submitted identifying a software tool other than MSET. The proposed tool must be able to meet all project goals and deliverables. The proposal will be evaluated for sufficient justification that the alternate software tool can provide equivalent capability and performance as MSET.

Task Scope of Work: The scope of work for this task is to assist with the implementation of on-line monitoring at each participating nuclear plant. The following sub-tasks describe the scope of work for FY 01 funding. The scope of follow-on tasks will be developed to achieve the overall objectives of this task and will depend on the results obtained and issues identified through the conduct of FY 01 funded tasks.

Subtask 1.1: System Modeling
Implementation assistance is necessary with regard to the initial setup and modeling of the selected on-line monitoring tool. The use of the term *model* refers to the correlated set of parameters that will be simultaneously monitored by the software, including the method by which the software will be trained for optimal performance. Consideration should be given to the following:

- Development of tools (e.g., cross correlation software that can be applied to multiple sensor signals, accompanied by written guidance for its use) to enable plant personnel to construct the appropriate models with a minimum of reliance on outside expertise.

- Development of "generic" models, applicable to a group of plants of similar design (e.g., Westinghouse newer plants), that could then be easily modified, as required, for use at a specific plant within that group.

Assist plants with the initial setup of the models for each application. Since each plant utilizes a large number of sensors, assume that a collection of separate models will be needed to optimize the selected on-line monitoring tool performance. Each model would contain sensor signals having a significant degree of correlation to the other sensor signals included in that model. The following are examples of the types of models that might be developed:

- Safety-related channels associated with the reactor coolant system and associated steam generator system for calibration and performance monitoring

- Feedwater and condensate system channels for the evaluation of feedwater venturi fouling

- Steam generator blowdown system channels for calibration and performance monitoring

- Secondary system channels for calibration and performance monitoring

- Turbine generator parameters for calibration and performance monitoring

- Chemical and volume control system channels for calibration and performance monitoring

- Plant efficiency analysis by monitoring secondary system process and electrical parameters

Subtask 1.2: Uncertainty Analysis
Nuclear plant setpoints (either safety-related or non-safety-related) are generally based on some process safety limit in which the setpoint allows for the various possible measurement errors. Nuclear plant personnel will have to understand the measurement uncertainty associated with on-line monitoring and the effect of this uncertainty on existing setpoints.

Complete an uncertainty analysis considering the following:

- Algorithm uncertainty

- Modeling guidelines and instrument correlation requirements

- System training requirements

- Variation as a function of the number of instruments/parameters included within a single model

Considering the above possible variations, the uncertainty shall be expressed at a 95 percent probability with a 95 percent confidence, as a minimum.

Subtask 1.3: Verification and Validation of the On-Line Monitoring Software Tool
Perform a verification and validation (V&V) of the software to document its accuracy and reliability. The purpose of this V&V effort is to develop the basis documentation necessary to allow the on-line monitoring tool to be used at operating nuclear plants.

Deliverable Items:
- Development and satisfactory operation of generic modeling tools for utility application
- Report expressing the uncertainty as a function of the various modeling and system operational variables.
- Completed verification and validation of on-line monitoring software tool

Task 5-117.3 Potential Nuclear Plant Vulnerabilities Arising From Transmission Grid Voltage Inadequacies

Estimated Available Funds for FY2001
The estimated FY 2001 available funds for this task in FY 2001 are $75,000.

Period of Performance for FY2001 Funding
The FY2001 award is for a 12-month performance period.

Project Period of Performance
The expected duration of the entire project is 30 months

Objective:

The overall objective of project 5-117 is to increase nuclear plant safety and protect the transmission grid from further instabilities caused when a nuclear unit might be forced off line due to grid voltage problems, by:

- Developing a risk monitor tool to assist transmission system managers in making difficult decisions involving low reserve margins, shortage of transmission facilities and technical problems in transmitting power over long lines.
- Providing return to service priorities to restore system margin or determining which assets to protect to prevent erosion of system margin.

Background:

This task is part of the work required to assess the vulnerability of nuclear power plants due to various transmission grid problems, such as voltage sag, congestion, or disruptions. As the electric utility industry undergoes its most fundamental restructuring in a century, the challenge of maintaining reliability is growing. With increases in inter-regional bulk power transfers and accelerating diversity of transactions among parties, the electric power grid is being used in ways for which it was not originally designed. Grid congestion and unusual power flows are increasing in a way that they degrade the voltage support required by a nuclear power plant's technical specifications --- and increase the probability that a nuclear plant, forced to trip off line for licensing or other reasons, will further destabilize the grid.

It should be noted that EPRI is already developing a Power Delivery Reliability Initiative that focuses on identifying ways to reduce the risk of further reliability problems. Part of this initiative is to develop a Real-Time Security Data Display (RSDD) that will provide a bird's eye view of the transmission grid reliability over a wide area. The RSDD will display flowgate and transmission loading relief (TLR) status with TLRs and low limit voltage color coding. Other 5-117 tasks are developing an interface between the RSDD and the nuclear plant equipment configuration risk management displays (e.g. EOOS, Safety Monitor) supported by the Risk and Reliability Workstation. These other tasks also are supporting a pilot effort to demonstrate the software between a nuclear plant and a transmission provider. The scope of the work to be funded in FY 2001 under this program announcement is described below.

Task Scope of Work: The task consists of developing models (and functional specifications) that anticipate instabilities in the local area of electric transmission networks from information obtained from wide(r) area sensing systems. A key part of the project will be to determine the degree of modeling required to obtain accurate results and the type of sensor information needed to provide the earliest indications of system instability. Algorithms will be needed to probabilistically characterize the likelihood of moving from a stable to an unstable network configuration, as well as network metrics for the probability/effects of load shed at particular nodes. The proposed functional specifications will be reviewed by plant operators and transmission providers to ensure compatibility with user needs.

The results will be presented on global/local basis with the ability to drill down to specific transmission zones. Maps and graphs will be used to help users to quickly identify bottlenecks in the system. The system will be able to analyze multiple transfer scenarios, for multiple seasonal load cases. The system will also have the ability to query the security applications to prioritize return-to-service options (both at the nuclear plant and on the grid), and identify equipment/generating assets/transmission capability most critical to maintaining current system margins. The functional requirements would be compatible with the Risk and Reliability Users Group Applications Program Interface software, and other modules currently being developed and accessed through the grid security interface modules.

Deliverable Items: A report describing technical specifications, data requirements, risk metrics, displays/drill downs, detailed cost and scheduling, and likely improvements. The results will be implemented in a second stage of the project, where the deliverable will be a software module(s) conforming to the functional specifications developed.